Fundamentals of Noise

NOISE

Noise is most often defined as unwanted sound; whether it is loud, unpleasant, unexpected, or otherwise undesirable. Although sound can be easily measured, the perception of noise and the physical response to sound complicate the analysis of its impact on people. People judge the relative magnitude of sound sensation in subjective terms such as "noisiness" or "loudness."

Noise Descriptors

The following are brief definitions of terminology used in this chapter:

- **Sound.** A disturbance created by a vibrating object, which, when transmitted by pressure waves through a medium such as air, is capable of being detected by a receiving mechanism, such as the human ear or a microphone.

- **Noise.** Sound that is loud, unpleasant, unexpected, or otherwise undesirable.

- **Decibel (dB).** A unitless measure of sound, expressed on a logarithmic scale and with respect to a defined reference sound pressure. The standard reference pressure is 20 micropascals (20 μPa).

- **A-Weighted Decibel (dBA).** An overall frequency-weighted sound level in decibels that approximates the frequency response of the human ear.

- **Equivalent Continuous Noise Level (L_{eq}); also called the Energy-Equivalent Noise Level.** The value of an equivalent, steady sound level which, in a stated time period (often over an hour) and at a stated location, has the same A-weighted sound energy as the time-varying sound. Thus, the L_{eq} metric is a single numerical value that represents the equivalent amount of variable sound energy received by a receptor over the specified duration.

- **Statistical Sound Level (L_n).** The sound level that is exceeded "n" percent of time during a given sample period. For example, the L_{50} level is the statistical indicator of the time-varying noise signal that is exceeded 50 percent of the time (during each sampling period); that is, half of the sampling time, the changing noise levels are above this value and half of the time they are below it. This is called the "median sound level." The L_{10} level, likewise, is the value that is exceeded 10 percent of the time (i.e., near the maximum) and this is often known as the "intrusive sound level." The L_{90} is the sound level exceeded 90 percent of the time and is often considered the "effective background level" or "residual noise level."

- **Maximum Sound Level (L_{max})**. The highest RMS sound level measured during the measurement period.
- **Root Mean Square Sound Level (RMS).** The square root of the average of the square of the sound pressure over the measurement period.

- **Day-Night Sound Level (L_{dn} or DNL).** The energy-average of the A-weighted sound levels occurring during a 24-hour period, with 10 dB added to the sound levels occurring during the period from 10:00 PM to 7:00 AM.

- **Community Noise Equivalent Level (CNEL).** The energy average of the A-weighted sound levels occurring during a 24-hour period, with 5 dB added from 7:00 PM to 10:00 PM and 10 dB from 10:00 PM to 7:00 AM. NOTE: For general community/environmental noise, CNEL and L_{dn} values rarely differ by more than 1 dB (with the CNEL being only slightly more restrictive – that is, higher than the L_{dn} value). As a matter of practice, L_{dn} and CNEL values are interchangeable and are treated as equivalent in this assessment.

- **Peak Particle Velocity (PPV).** The peak rate of speed at which soil particles move (e.g., inches per second) due to ground vibration.

- **Sensitive Receptor.** Noise- and vibration-sensitive receptors include land uses where quiet environments are necessary for enjoyment and public health and safety. Residences, schools, motels and hotels, libraries, religious institutions, hospitals, and nursing homes are examples.

Characteristics of Sound

When an object vibrates, it radiates part of its energy in the form of a pressure wave. Sound is that pressure wave transmitted through the air. Technically, airborne sound is a rapid fluctuation or oscillation of air pressure above and below atmospheric pressure that creates sound waves.

Sound can be described in terms of amplitude (loudness), frequency (pitch), or duration (time). Loudness or amplitude is measured in dB, frequency or pitch is measured in Hertz [Hz] or cycles per second, and duration or time variations is measured in seconds or minutes.

Amplitude

Unlike linear units such as inches or pounds, decibels are measured on a logarithmic scale. Because of the physical characteristics of noise transmission and perception, the relative loudness of sound does not closely match the actual amounts of sound energy. Table 1 presents the subjective effect of changes in sound pressure levels. Ambient sounds generally range from 30 dBA (very quiet) to 100 dBA (very loud). Changes of 1 to 3 dB are detectable under quiet, controlled conditions, and changes of less than 1 dB are usually not discernible (even under ideal conditions). A 3 dB change in noise levels is considered the minimum change that is detectable with human hearing in outside environments. A change of 5 dB is readily discernible to most people in an exterior environment, and a 10 dB change is perceived as a doubling (or halving) of the sound.

Table 1 Noise Perceptibility

Change in dB	Noise Level
± 3 dB	Barely perceptible increase
± 5 dB	Readily perceptible increase
± 10 dB	Twice or half as loud
± 20 dB	Four times or one-quarter as loud

Source: California Department of Transportation (Caltrans). 2013, September. Technical Noise Supplement ("TeNS").

Frequency

The human ear is not equally sensitive to all frequencies. Sound waves below 16 Hz are not heard at all, but are "felt" more as a vibration. Similarly, though people with extremely sensitive hearing can hear sounds as high as 20,000 Hz, most people cannot hear above 15,000 Hz. In all cases, hearing acuity falls off rapidly above about 10,000 Hz and below about 200 Hz.

When describing sound and its effect on a human population, A-weighted (dBA) sound levels are typically used to approximate the response of the human ear. The A-weighted noise level has been found to correlate well with people's judgments of the "noisiness" of different sounds and has been used for many years as a measure of community and industrial noise. Although the A-weighted scale and the energy-equivalent metric are commonly used to quantify the range of human response to individual events or general community sound levels, the degree of annoyance or other response also depends on several other perceptibility factors, including:

- Ambient (background) sound level
- General nature of the existing conditions (e.g., quiet rural or busy urban)
- Difference between the magnitude of the sound event level and the ambient condition
- Duration of the sound event
- Number of event occurrences and their repetitiveness
- Time of day that the event occurs

Duration

Time variation in noise exposure is typically expressed in terms of a steady-state energy level equal to the energy content of the time varying period (called L_{eq}), or alternately, as a statistical description of the sound level that is exceeded over some fraction of a given observation period. For example, the L_{50} noise level represents the noise level that is exceeded 50 percent of the time; half the time the noise level exceeds this level and half the time the noise level is less than this level. This level is also representative of the level that is exceeded 30 minutes in an hour. Similarly, the L_2, L_8 and L_{25} values represent the noise levels that are exceeded 2, 8, and 25 percent of the time or 1, 5, and 15 minutes per hour, respectively. These "n" values are typically used to demonstrate compliance for stationary noise sources with many cities' noise ordinances. Other values typically noted during a noise survey are the L_{min} and L_{max}. These values represent the minimum and maximum root-mean-square noise levels obtained over the measurement period, respectively.

Because community receptors are more sensitive to unwanted noise intrusion during the evening and at night, state law and many local jurisdictions use an adjusted 24-hour noise descriptor called the Community Noise Equivalent Level (CNEL) or Day-Night Noise Level (L_{dn}). The CNEL descriptor requires that an artificial increment (or "penalty") of 5 dBA be added to the actual noise level for the hours from 7:00 PM to 10:00 PM and 10 dBA for the hours from 10:00 PM to 7:00 AM. The L_{dn} descriptor uses the same methodology except that there is no artificial increment added to the hours between 7:00 PM and 10:00 PM. Both descriptors give roughly the same 24-hour level, with the CNEL being only slightly more restrictive (i.e., higher). The CNEL or L_{dn} metrics are commonly applied to the assessment of roadway and airport-related noise sources.

Sound Propagation

Sound dissipates exponentially with distance from the noise source. This phenomenon is known as "spreading loss." For a single-point source, sound levels decrease by approximately 6 dB for each doubling of distance from the source (conservatively neglecting ground attenuation effects, air absorption factors, and barrier shielding). For example, if a backhoe at 50 feet generates 84 dBA, at 100 feet the noise level would be 79 dBA, and at 200 feet it would be 73 dBA. This drop-off rate is appropriate for noise generated by on-site operations from stationary equipment or activity at a project site. If noise is produced by a line source, such as highway traffic, the sound decreases by 3 dB for each doubling of distance over a reflective ("hard site") surface such as concrete or asphalt. Line source noise in a relatively flat environment with ground-level absorptive vegetation decreases by an additional 1.5 dB for each doubling of distance.

Psychological and Physiological Effects of Noise

Physical damage to human hearing begins at prolonged exposure to noise levels higher than 85 dBA. Exposure to high noise levels affects the entire system, with prolonged noise exposure in excess of 75 dBA increasing body tensions, thereby affecting blood pressure and functions of the heart and the nervous system. Extended periods of noise exposure above 90 dBA results in permanent cell damage, which is the main driver for employee hearing protection regulations in the workplace. For community environments, the ambient or background noise problem is widespread, through generally worse in urban areas than in outlying, less-developed areas. Elevated ambient noise levels can result in noise interference (e.g., speech interruption/masking, sleep disturbance, disturbance of concentration) and cause annoyance. Since most people do not routinely work with decibels or A-weighted sound levels, it is often difficult to appreciate what a given sound pressure level number means. To help relate noise level values to common experience, Table 2 shows typical noise levels from familiar sources.

Table 2 Typical Noise Levels

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
Onset of physical discomfort	120+	
	110	Rock Band (near amplification system)
Jet Flyover at 1,000 feet		
	100	
Gas Lawn Mower at three feet		
	90	
Diesel Truck at 50 feet, at 50 mph		Food Blender at 3 feet
	80	Garbage Disposal at 3 feet
Noisy Urban Area, Daytime		
	70	Vacuum Cleaner at 10 feet
Commercial Area		Normal speech at 3 feet
Heavy Traffic at 300 feet	60	
		Large Business Office
Quiet Urban Daytime	50	Dishwasher Next Room
Quiet Urban Nighttime	40	Theater, Large Conference Room (background)
Quiet Suburban Nighttime		
	30	Library
Quiet Rural Nighttime		Bedroom at Night, Concert Hall (background)
	20	
		Broadcast/Recording Studio
	10	
Lowest Threshold of Human Hearing	0	Lowest Threshold of Human Hearing

Source: California Department of Transportation (Caltrans). 2013, September. Technical Noise Supplement ("TeNS").

Vibration Fundamentals

Vibration is an oscillatory motion through a solid medium in which the motion's amplitude can be described in terms of displacement, velocity, or acceleration. Vibration is normally associated with activities stemming from operations of railroads or vibration-intensive stationary sources, but can also be associated with construction equipment such as jackhammers, pile drivers, and hydraulic hammers. As with noise, vibration can be described by both its amplitude and frequency. Vibration displacement is the distance that a point on a surface moves away from its original static position; velocity is the instantaneous speed that a point on a surface moves; and acceleration is the rate of change of the speed. Each of these descriptors can be used to correlate vibration to human response, building damage, and acceptable equipment vibration levels. During construction, the operation of construction equipment can cause groundborne vibration. During the operational phase of a project, receptors may be subject to levels of vibration that can cause annoyance due to noise generated from vibration of a structure or items within a structure.

Vibration amplitudes are usually described in terms of either the peak particle velocity (PPV) or the root mean square (RMS) velocity. PPV is the maximum instantaneous peak of the vibration signal and RMS is the

square root of the average of the squared amplitude of the signal. PPV is more appropriate for evaluating potential building damage and RMS is typically more suitable for evaluating human response.

As with airborne sound, annoyance with vibrational energy is a subjective measure, depending on the level of activity and the sensitivity of the individual. To sensitive individuals, vibrations approaching the threshold of perception can be annoying. Persons accustomed to elevated ambient vibration levels, such as in an urban environment, may tolerate higher vibration levels. Table 3 displays the human response and the effects on buildings resulting from continuous vibration (in terms of various levels of PPV).

Table 3 Human Reaction to Typical Vibration Levels

Vibration Level, PPV (in/sec)	Human Reaction	Effect on Buildings
0.006–0.019	Threshold of perception, possibility of intrusion	Vibrations unlikely to cause damage of any type
0.08	Vibrations readily perceptible	Recommended upper level of vibration to which ruins and ancient monuments should be subjected
0.10	Level at which continuous vibration begins to annoy people	Virtually no risk of "architectural" (i.e. not structural) damage to normal buildings
0.20	Vibrations annoying to people in buildings	Threshold at which there is a risk to "architectural" damage to normal dwelling – houses with plastered walls and ceilings
0.4–0.6	Vibrations considered unpleasant by people subjected to continuous vibrations and unacceptable to some people walking on bridges	Vibrations at a greater level than normally expected from traffic, but would cause "architectural" damage and possibly minor structural damage

Source: California Department of Transportation (Caltrans). 2020, April. *Transportation and Construction Vibration Guidance Manual*. Prepared by ICF International.

LOCAL REGULATIONS AND STANDARDS

Noise Element

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INTRODUCTION

The City of Anaheim is affected by several sources of noise, including vehicular traffic, entertainment facilities, sports events, commercial and industrial activity, and periodic occurrences such as construction and aircraft travel. Excessive levels of noise can affect the physical health, psychological stability, property values, and economic productivity of Anaheim and its residents. The control of noise, therefore, is an essential component in creating a safe, compatible, and productive environment.

ACHIEVING THE VISION

The citizens of Anaheim understand the relationship between noise and their health and serenity. As a part of the visioning process that shaped this general plan update, citizens and City officials identified goals for the future relating to balancing land uses in the City, in part to minimize incompatibilities and exposure to excessive noise while providing the range of uses needed to maintain a high quality of life. These goals are reflected in the Noise Element of this General Plan.

UNDERSTANDING NOISE

Definitions

The following is a list of commonly used terms and abbreviations that may be found within this Element or when discussing the topic of noise. This is an abbreviated glossary that should be reviewed prior to reading the Element. Figure N-1, *Sources of Sound*, is presented following this glossary to illustrate the level of noise generated by common everyday occurrences. It is important to become familiar with these definitions in order to better understand information contained in the Noise Element.

- **Ambient Noise** – The composite of noise from all sources near and far. In this context, the ambient noise level constitutes the normal or existing level of environmental (background) noise at a given location.

- **Intrusive Noise** – That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency and time of occurrence, and tonal or informational content.
- **dB (Decibel)** – The unit of measure that denotes the ratio between two quantities that are proportional to power; the number of decibels corresponding to the ratio of the two amounts of power is based on a logarithmic scale.
- **dBA (A-weighted decibel)** – The A-weighted decibel scale discriminates against upper and lower frequencies in a manner approximating the sensitivity of the human ear. The scale ranges from zero for the average least perceptible sound to about 130 for the average pain level.
- **L_{50}** – The A-weighted sound level that is exceeded 50% of the sample time. Alternatively, the A-weighted sound level that is exceeded 30 minutes in a 60-minute period (similarly, L_{10}, L_{25}, etc.). These values are typically used to demonstrate compliance with noise restrictions included in the City noise ordinance.
- **L_{eq} (Equivalent Energy Level)** – The average acoustic energy content of noise during the time it lasts. The L_{eq} of a time-varying noise and that of a steady noise are the same if they deliver the same acoustic energy to the ear during exposure, no matter what time of day they occur.
- **L_{dn} (Day-Night Average Level)** – The average equivalent A-weighted sound level during a 24-hour day, obtained after the addition of 10 decibels to sound levels in the night from 10:00 p.m. to 7:00 a.m. Note: CNEL and L_{dn} represent daily levels of noise exposure averaged on an annual or daily basis, while Leq represents the equivalent energy noise exposure for a shorter time period, typically one hour. CNEL and L_{dn} are the metrics used in this document to describe annoyance due to noise and to establish land use planning criteria for noise.
- **L_{max} (Maximum Energy Level)** – The maximum sound level (dB) observed during a particular noise event. More specifically, it is the greatest root-mean-square noise value obtained over the measurement period.
- **CNEL (Community Noise Equivalent Level)** – The average equivalent A-weighted sound level during a 24-hour day, obtained after the addition of five decibels to sound levels in the evening from 7:00 p.m. to 10:00 p.m. and after the addition of 10 decibels to sound levels in the night from 10:00 p.m. to 7:00 a.m. CNEL and L_{dn} are the metrics used in this document to describe annoyance due to noise and to establish land use planning criteria for noise.
- **Noise Contours** – Lines drawn around a noise source indicating equal levels of noise exposure.

- **Vibration** – Another community annoyance related to noise is vibration. As with noise, vibration can be described by both its amplitude and frequency. Amplitude may be characterized by displacement, velocity, and/or acceleration. Typically, particle velocity (measured in inches or millimeters per second) and/or acceleration (measured in gravities) are used to describe vibration.

  Vibration can be felt outdoors, but the perceived intensity of vibration impacts is much greater indoors, due to structural shaking. Some of the most common sources of vibration come from trains, transit vehicles, construction equipment, airplanes, and trucks. Several land uses are especially sensitive to vibration, and therefore have a lower vibration threshold. These uses include, but are not limited to, concert halls, hospitals, libraries, vibration-sensitive research or manufacturing operations, residential areas, schools, and offices.

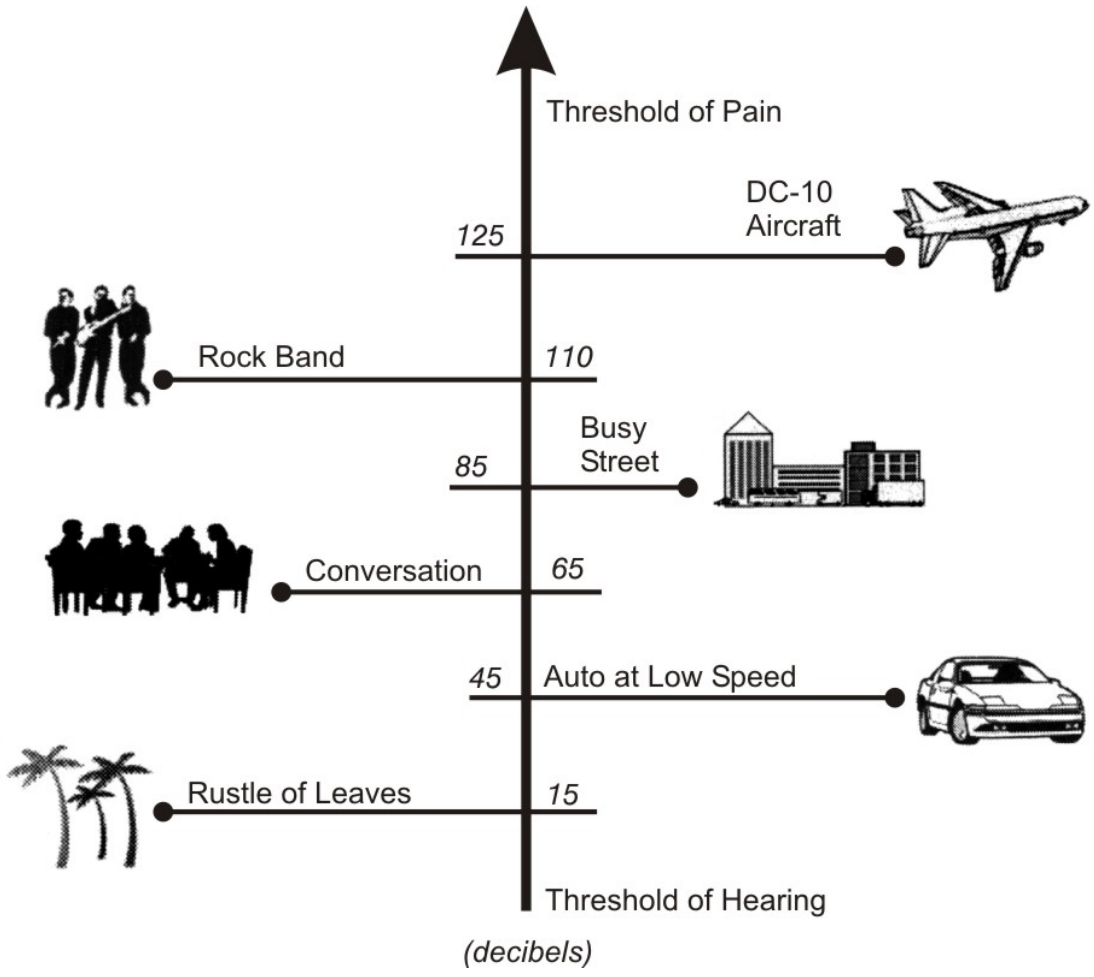


Figure N-1 Sources of Sound

RELATIONSHIP TO OTHER DOCUMENTS

The Noise Element is a comprehensive approach towards incorporating noise control in the planning process. It is a tool for achieving and maintaining environmental noise levels compatible with land use. The Noise Element identifies noise sensitive land uses and noise sources, and defines areas of noise impact. The Element establishes goals, policies, and programs to ensure that Anaheim residents will be protected from excessive noise.

Related General Plan Elements

The Noise Element is closely related to the Circulation and Land Use Elements. Transit thoroughfares such as freeways, arterial highways, and railways generate the majority of noise within the City and influence the type and intensity of development within a given area. Likewise, land uses sensitive to noise such as schools and residences are to be considered when determining land use patterns and planned mitigation measures related to noise impacts. The location and amount of such noise generators and receptors are also important considerations in the Public Services and Facilities and Green Elements. These elements address issues such as the development of educational facilities, public parks, and open space buffers.

Other Regulatory Documents

The intent of the Noise Element is to set goals to limit and reduce the effects of noise intrusion and to set acceptable noise levels for varying types of land uses. To this end, the City has the authority to set land use noise standards and place restrictions on private activities that generate excessive or intrusive noise. However, it should be recognized that the City does not have the authority to regulate all sources of noise within the City and various other agencies may supercede City authority.

Federal Highway Administration

State routes and freeways that run through the City are subject to Federal funding and, as such, are under the purview of the Federal Highway Administration (FHWA). The FHWA has developed noise standards that are typically used for Federally-funded roadway projects or projects that require either Federal or Caltrans review. These noise standards are based on Leq and L_{10} values and are included in Table N-1, *FHWA Design Noise Levels*.

TABLE N-1: FHWA DESIGN NOISE LEVELS			
Activity Category	Description of Activity Category	Design Noise Levels [1] L_{eq} (dBA)	L_{10} (dBA)
A	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose. Examples include natural parks or wildlife habitat.	57 (exterior)	60 (exterior)
B	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.	67 (exterior)	70 (exterior)
C	Developed lands, properties, or activities not included in Categories A or B, above.	72 (exterior)	75 (exterior)
D	Undeveloped lands.	---	---
E	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.	52 (interior)	55 (interior)

[1] Either L_{eq} or L_{10} (but not both) design noise levels may be used on a project.

U.S. Department of Housing and Urban Development

The Department of Housing and Urban Development (HUD) issues formal requirements related specifically to standards for exterior noise levels along with policies for approving HUD-supported or assisted housing projects in high noise areas. In general, these requirements established three zones. These include:

- **65 dBA L_{dn} or less -** an **acceptable zone** where all projects could be approved,
- **Exceeding 65 dBA L_{dn} but not exceeding 75 dBA L_{dn} -** a **normally unacceptable zone** where mitigation measures would be required and each project would have to be individually evaluated for approval or denial. These measures must provide 5 dBA of attenuation above the attenuation provided by standard construction required in a 65 to 70 dBA L_{dn} area and 10 dBA of attenuation in a 70 to 75 dBA L_{dn} area, and
- **Exceeding 75 dBA L_{dn} -** an **unacceptable zone** in which projects would not, as a rule, be approved.

Federal Railroad Administration

The EPA is charged with the regulation of railroad noise under the Noise Control Act. The EPA Office of Noise Abatement and Control was closed in 1982, leaving the

enforcement of EPA regulations to the Federal Railroad Administration (FRA). Table N-2, *Summary of EPA/FRA Railroad Noise Standards*, summarizes the EPA railroad noise standards that set operating noise standards for railroad equipment and set noise limit standards for new equipment.

TABLE N-2: SUMMARY OF EPA/FRA RAILROAD NOISE STANDARDS

Noise Sources	Operating Conditions	Noise Metric[1, 2]	Measured Distance (feet)	Standard (dBA)
Non-Switcher Locomotives built on or before 12/31/79	Stationary	L_{max} (Slow)	100	73
	Idle Stationary	L_{max} (Slow)	100	93
	Non-Idle Moving	L_{max} (Fast)	100	95
Switcher Locomotives plus Non-Switcher Locomotives built after 12/31/79	Stationary	L_{max} (Slow)	100	70
	Idle Stationary	L_{max} (Slow)	100	87
	Non-Idle Moving	L_{max} (Fast)	100	90
Rail Cars	Speed $\leq$ 45 mph	L_{max} (Fast)	100	88
	Speed > 45 mph	L_{max} (Fast)	100	93
	Coupling	Adj. Avg. Max.	50	92

[1] Slow and fast exponential-time-weighting is used.
[2] Note that these values are in terms of the Lmax, and can be considerably greater than the Leq typically used in the measurement of obtrusive noise.
Source: United States Environmental Protection Agency Railroad Noise Emission Standard (40 Code of Federal Regulations Part 201).

California Department of Health Services

The California Department of Health Services (DHS) Office of Noise Control studied the correlation of noise levels and their effects on various land uses. As a result, the DHS established four categories for judging the severity of noise intrusion on specified land uses.

Figure N-2, *Land Use Compatibility for Community Noise Exposure (Exterior)*, presents a land use compatibility chart for community noise prepared by the California Office of Noise Control and adopted in this Noise Element to demonstrate land-use compatibility. While the chart is presented in terms of the L_{dn} or CNEL, the City prefers the use of the CNEL descriptor, as it is slightly more conservative (i.e., restrictive), in protecting sensitive land uses.

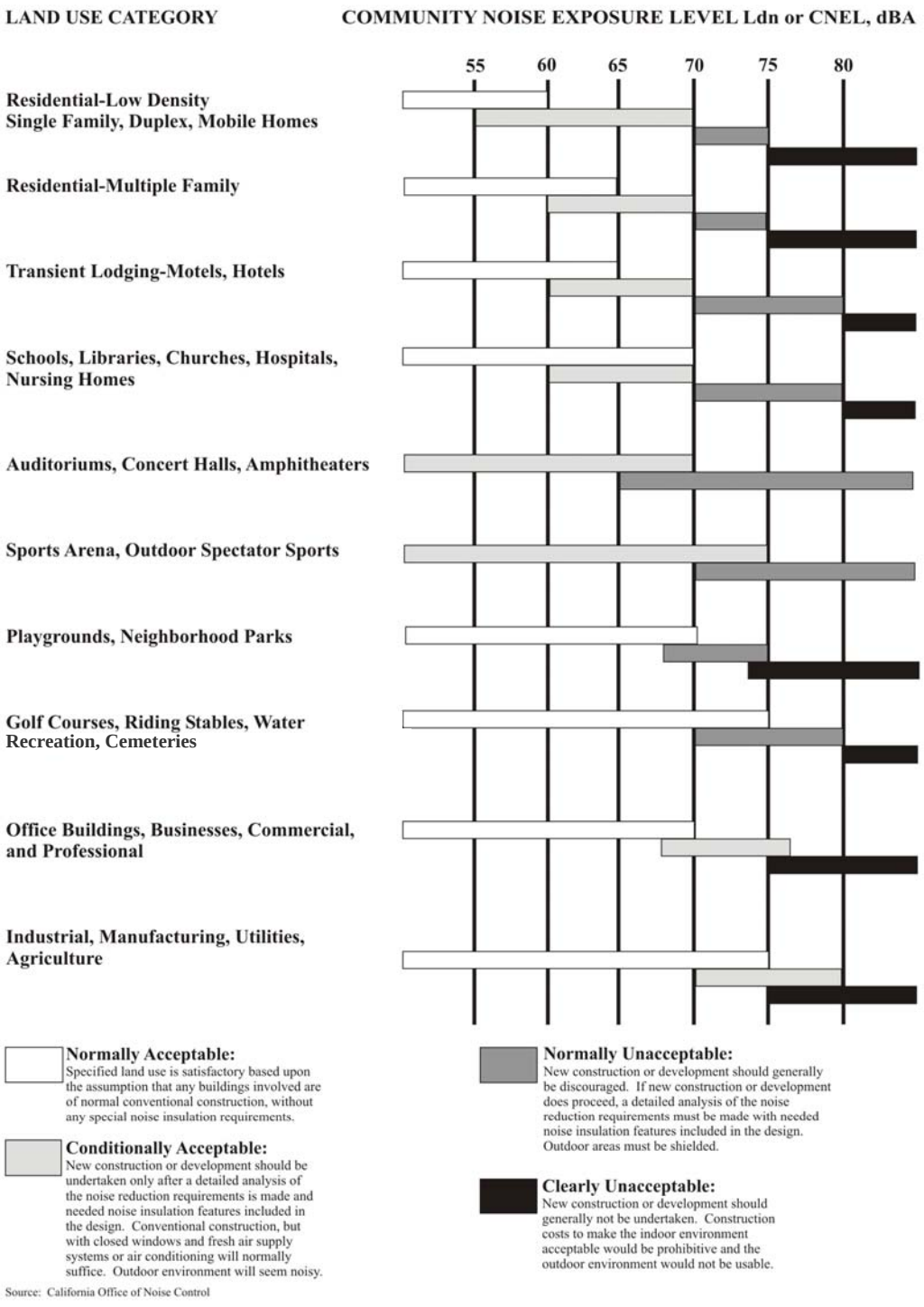


Figure N-2 Land Use Compatibility for Community Noise Exposure (Exterior)

It identifies "normally acceptable," "conditionally acceptable," "normally unacceptable," and "clearly unacceptable" exterior noise levels for various land uses. A "conditionally acceptable" designation implies new construction or development should be undertaken only after a detailed analysis of the noise reduction requirements for each land use is made and needed noise insulation features are incorporated in the design. By comparison, a "normally acceptable" designation indicates that standard construction can occur with no special noise reduction requirements.

While this land use compatibility chart is based on a 24-hour value, the City is aware that some land uses are not occupied on a 24-hour basis, and a descriptor (such as L_{dn} or CNEL) may be overly restrictive in siting these types of sensitive land uses. Such uses may include, but are not limited to, schools, libraries, and churches. In these cases, a more appropriate standard would consider the time of occupancy of the land use. Here, the City recommends the use of a 65 dBA, 12-hour L_{eq} ($L_{eq}(12)$) that includes those hours of actual use. (If a facility is to be used in excess of 12 hours per day, the CNEL standard should be used.)

Table N-3, *State of California Interior and Exterior Noise Standards*, includes the State interior and exterior noise standards for varying land uses. It is important to note that the exterior noise levels are to be attained in "habitable" exterior areas and need not encompass the entirety of a property and that special consideration should be given in the case of infill residential development located along the City's arterial corridors or railroad lines in order to achieve an appropriate balance between providing a quality living environment and attractive project design.

TABLE N-3: STATE OF CALIFORNIA INTERIOR AND EXTERIOR NOISE STANDARDS

Land Use		CNEL (dBA)	
Categories	**Uses**	**Interior [1]**	**Exterior [2]**
Residential	Single and multiple-family, duplex	45[3]	65
	Mobile homes	----	65[4]
Commercial	Hotel, motel, transient housing	45	---
	Commercial retail, bank, restaurant	55	---
	Office building, research and development, professional offices	50	---
	Amphitheater, concert hall, auditorium, movie theater	45	---
	Gymnasium (Multipurpose)	50	---
	Sports Club	55	---
	Manufacturing, warehousing, wholesale, utilities	65	---
	Movie Theaters	45	---
Institutional/ Public	Hospital, school classrooms/playgrounds	45	65
	Church, library	45	---
Open Space	Parks	---	65

[1] Indoor environment excluding: bathrooms, kitchens, toilets, closets, and corridors

[2] Outdoor environment limited to:

- Private yard of single-family dwellings
- Multiple-family private patios or balconies accessed from within the dwelling (Balconies 6 feet deep or less are exempt)
- Mobile home parks
- Park picnic areas
- School playgrounds
- Hospital patios

[3] Noise level requirement with closed windows, mechanical ventilation or other means of natural ventilation shall be provided as per Chapter 12, Section 1205 of the Uniform Building Code.

[4] Exterior noise levels should be such that interior noise levels will not exceed 45 dBA CNEL.

City of Anaheim Noise Ordinance

The City of Anaheim has the authority to set land use noise standards and place restrictions on private activities that generate excessive or intrusive noise. The applicable standards for these activities are specified in the Anaheim Municipal Code. The Municipal Code limits sound levels for stationary sources of noise radiated for extended periods from any premises in excess of 60 decibels at the property line. Sound created by construction or building repair of any premises within the City is also exempt from the applications of the Municipal Code during the hours of 7:00 a.m. and 7:00 p.m.

Traffic sounds, sound created by emergency activities and sound created by governmental units are exempt from the applications of the Municipal Code. To this end, for land use planning, the City's Noise Element has adopted the State of California standards as included in Table N-3, *State of California Interior and Exterior Noise Standards*.

GOALS AND POLICIES

This section contains a brief discussion and detailed policy direction for noise issues within Anaheim. The first issue, Land Use Planning and Design, concerns the relationship between the design and approval of land uses and existing or potential noise sources. The second issue, Transportation Related Noise Sources, considers impacts that can be created by the operation of motor vehicles, trucks, aircraft and railways in the City. Non-Transportation Related Noise Sources, the third issue, involves noise impacts created by business or residential activities, such as air conditioning units, manufacturing activities, barking dogs, or community events. By following the policies associated with each issue, Anaheim will ensure compatible development, protect noise sensitive land uses, and minimize the effects of excessive and nuisance noise.

Land Use Planning and Design

Although the City is largely built-out, the growth in population, employment and tourist activity may generate more traffic and attract additional noise producing uses. In addition, some undeveloped and underdeveloped areas are designated for land uses that may be noise-sensitive and are located in proximity to roadways, railroads and transit facilities. For example, in some areas of the City, mixed-use and higher density residential development is encouraged in close proximity to transportation facilities to improve transit accessibility and, in turn, improve traffic efficiencies. In addition, some of these same uses are located in areas that are transitioning from potential noise-generating industrial uses to other uses. As a result, land use compatibility with noise is an important consideration in the planning and design process.

In order to identify potential mitigation to address noise abatement strategies, noise evaluations should be conducted when a proposed project places sensitive land uses and major noise generators within close proximity to each other. The City's Planning Department currently uses the project review process to identify potential noise issues

and works with developers or landowners to apply site planning and other design strategies to reduce noise impacts. A developer, for example, could take advantage of the natural shape and contours of a site to arrange buildings and other uses in a manner that would reduce and possibly eliminate noise impacts. Examples of other site and architectural techniques could include:

- Increasing the distance between noise source and receiver.
- Placing non-noise sensitive land uses such as parking lots, maintenance facilities and utility areas between the noise source and receiver, while maintaining aesthetic considerations.
- Using non-noise sensitive structures such as garages to shield noise-sensitive areas.
- Orienting buildings to shield outdoor spaces from a noise source.
- Locating bedrooms in residential developments on the side of the house facing away from major roads.

GOAL 1.1:

Protect sensitive land uses from excessive noise through diligent planning and regulation.

Policies:

1) Update City regulations to adopt Land Use Compatibility for Community Noise Exposure and California Interior and Exterior Noise Standards as appropriate.

2) Continue to enforce acceptable noise standards consistent with health and quality of life goals and employ effective techniques of noise abatement through such means as a noise ordinance, building codes, and subdivision and zoning regulations.

3) Consider the compatibility of proposed land uses with the noise environment when preparing, revising or reviewing development proposals.

4) Require mitigation where sensitive uses are to be placed along transportation routes to ensure that noise levels are minimized through appropriate means of mitigation thereby maintaining quality of life standards.

5) Encourage proper site planning and architecture to reduce noise impacts.

6) Discourage the siting of sensitive uses in areas in excess of 65 dBA CNEL without appropriate mitigation.

7) Require that site-specific noise studies be conducted by a qualified acoustic consultant utilizing acceptable methodologies while reviewing the

development of sensitive land uses or development that has the potential to impact sensitive land uses.

Transportation Related Noise Sources

Anaheim contains a number of transportation-related noise sources including freeways, arterial highways, collector roadways, helicopter, and railroad operations. These sources are the major contributors of noise in Anaheim. Cost effective strategies to reduce their influence on the community noise environment are an essential part of the Noise Element. While local government has little direct control of transportation noise at the source, as these levels are set by State and Federal agencies, the City does have some control over transportation noise that exceeds State and/or Federal standards through the enforcement of the Municipal Code.

The most effective method the City has to mitigate transportation noise is by reducing the impact of the noise onto the community through noise barriers and site design review. The effect of a noise barrier is critically dependent on the distance between the noise source and the receiver. A noise barrier effect occurs when the barrier penetrates the "line of sight" between the source and receiver; the greater the penetration or height of the barrier, the greater the noise reduction. Additional attenuation can be achieved depending upon the source of transportation related noise.

Roadways

Roadways are one of the biggest sources of noise in the City. Everyday, thousands of vehicles travel through and around Anaheim. Sound emanates from the vehicles' engines and from the tires rolling over the pavement. One way the City can control vehicle noise is through speed reduction. A change of just 5 miles per hour can change the resultant noise by approximately one to two dBA. The difference in noise associated with a reduction of 10 miles per hour could be roughly equivalent to reducing the traffic volume by one-half.

The City also has some control over traffic-generated noise through weight limitations and the designation of truck routes. Medium trucks, (i.e., those with a gross vehicle weight between 5 and 13.25 tons) produce as much acoustical energy as approximately 5 to 16 automobiles depending on the speed, with slower speeds demonstrating greater differential. Similarly, heavy trucks (i.e., those with a gross vehicle weight in excess of 13.25 tons) produce as much acoustical energy as 10 to 60 automobiles.

The City can further reduce traffic-generated noise by ensuring that street paving is maintained and bumps and dips are minimized. Poor paving causes vehicles to bounce and this bouncing exacerbates the noise due to the rattling of the vehicle. This is especially important along those routes that realize augmented volumes of truck traffic. Noise contours for the City's roadways and freeways are presented in Figure N-3, *Future*

Roadway Noise Contours, and Figure N-4, *Future Freeway and Railroad Noise Contours.* Future conditions consider sound levels given the buildout of land uses and the roadway network, but do not consider sound attenuation measures such as soundwalls.

Aircraft

The City is not located within the 65 dBA CNEL contours for any commercial or private airports, and fixed-wing aircraft are typically too high to add measurably to local noise. However, local helicopter air traffic is commonplace throughout the City. News and other helicopters (e.g., freeway traffic report helicopters) fly through the area, but do not land within the City.

Helicopter use at hospitals is considered as an emergency activity and as such, is exempt under the City Municipal Code. Fire and police helicopter use for emergency functions also fall under this exclusion. Low-flying helicopter activity, however, has been a source of noise complaints within the City, particularly in the Anaheim Colony, and indicates that the siting of future heliports, regardless of their use, must be carefully reviewed for potential noise impacts.

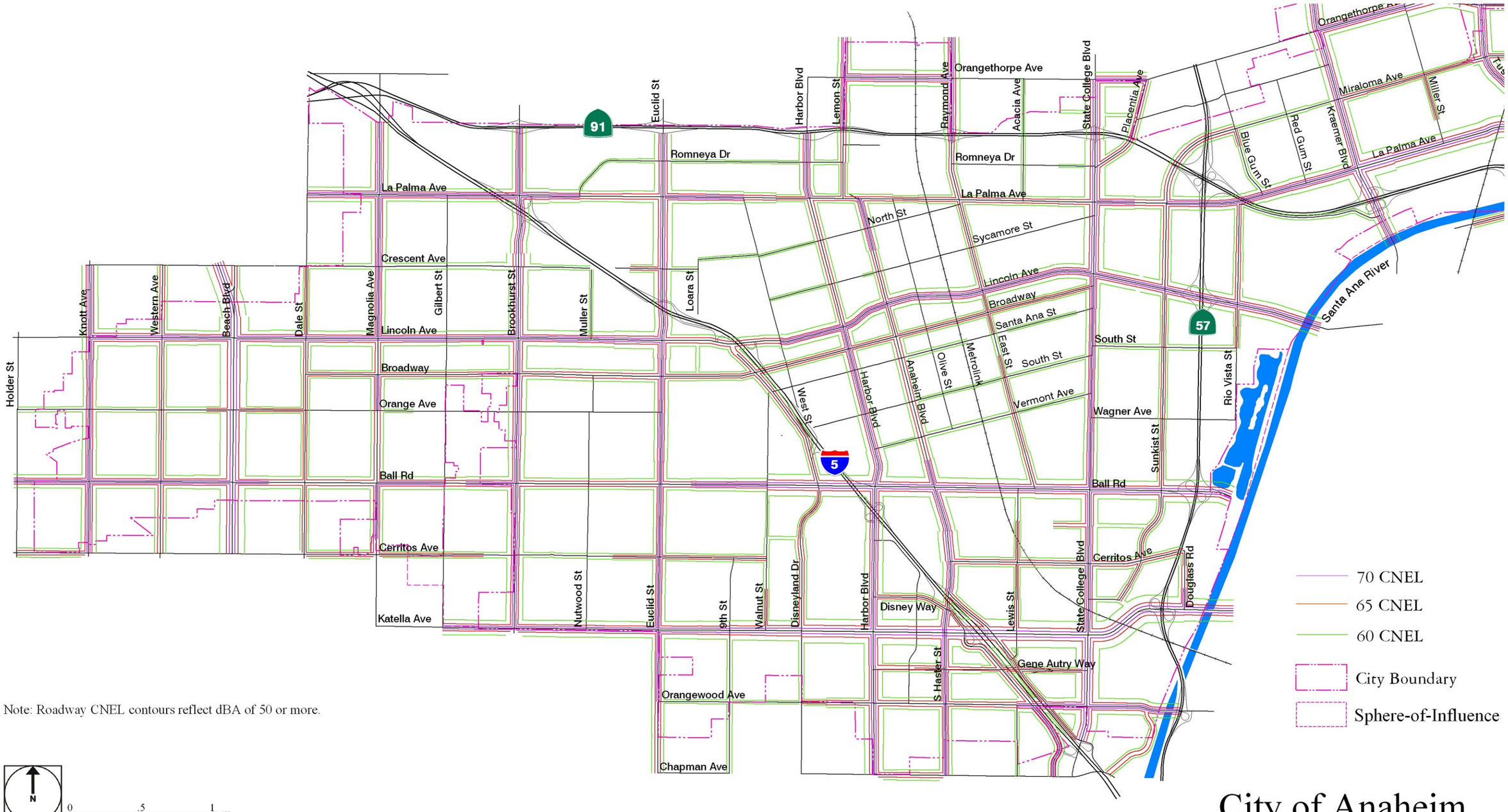
Railways

Another prevalent source of noise in the City is from railroad operations. The City contains two train stations that are used by Metrolink and Amtrak for passenger rail service. Both Metrolink and Amtrak operate out of the Anaheim Station, which is located adjacent to the Angel Stadium of Anaheim. Metrolink also stops at the Anaheim Canyon Station, which is situated near the intersection of North Tustin Avenue and the Riverside (SR-91) Freeway. In addition, the City contains two railroad freight corridors. These include the Union Pacific line located primarily along the Santa Ana (I-5) Freeway, but diverging in the southern portions of the City, and the Burlington Northern & Santa Fe (BN&SF) line located along Orangethorpe Avenue/ Esperanza Road.

Currently, daily train traffic produces noise that may disrupt activities in proximity to railroad tracks. For example, trains are required to sound their horns at all at-grade crossings. Trains may also be required to slow their speed through residential areas. These types of noise disturbances can interfere with activities conducted on noise-sensitive land uses.

Railroad noise is dependant on a number of factors including the number of operations per day, the times these operations occur, the numbers of engines and railcars, the speed, the type of rail (i.e., continuous or bolted), and whether at-grade rail crossings exist that require engineers to sound a warning horn. Noise contours for railway operations are presented in Figure N-3, *Future Roadway Noise Contours*.

Future Roadway Noise Contours



Note: Roadway CNEL contours reflect dBA of 50 or more.

City of Anaheim

General Plan Program

Figure N-3a Page N-15

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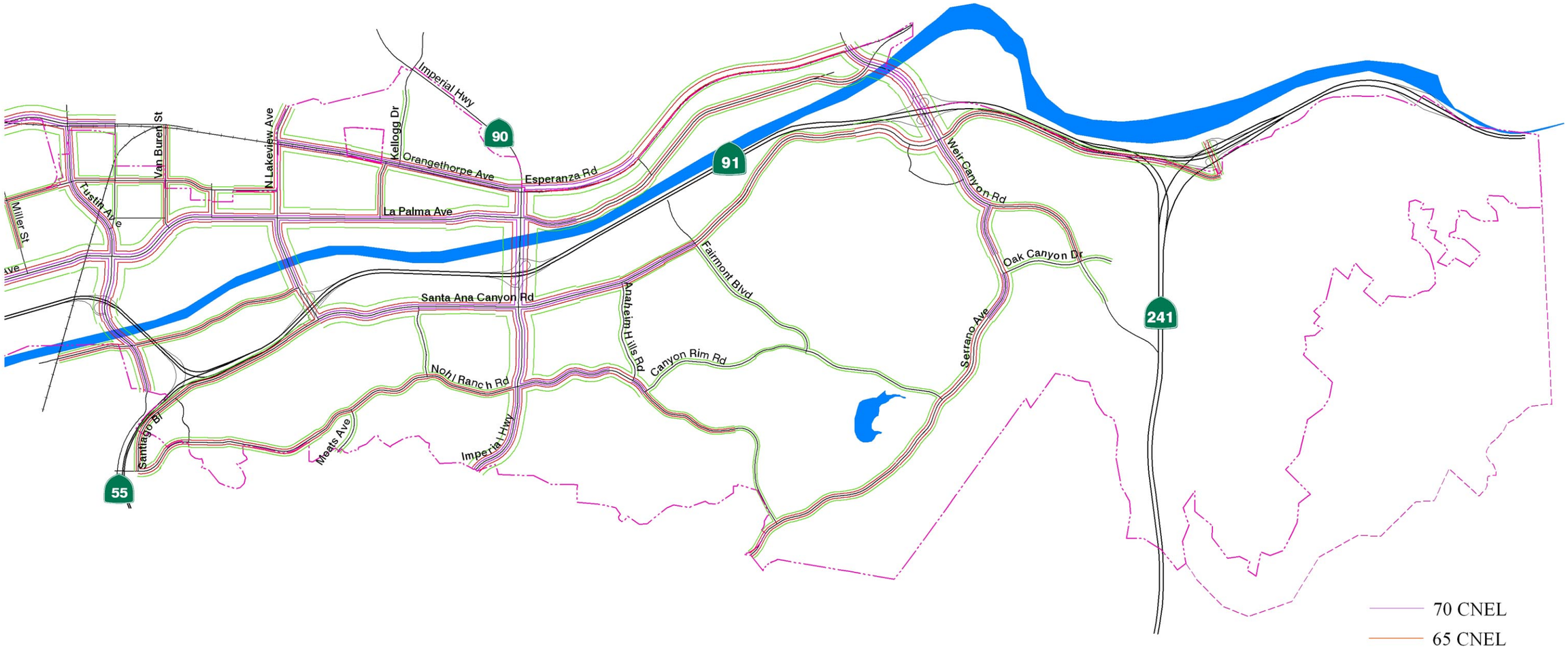
Future Roadway Noise Contours



Note: Roadway CNEL contours reflect dBA of 50 or more.

N

0 .5 1 Miles

City of Anaheim

General Plan Program

Figure N-3b Page N-17

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Future Freeway and Railroad Noise Contours

City of Anaheim

General Plan Program

Figure N-4 Page N-19

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Alternative Transportation

The City can also minimize traffic-generated noise by encouraging the construction and use of alternative modes of transportation such as alternative fuel vehicles, the Bus Rapid Transit (BRT) System, or transit oriented design (TOD) – the provision of higher density, mixed-use development near major rail and transit stops. Alternative transportation modes can emit less noise per passenger than their automotive counterparts and can reduce traffic congestion. Additional information on TOD and the BRT System can be found in the Green and Circulation Elements.

GOAL 2.1:

Encourage the reduction of noise from transportation-related noise sources such as motor vehicles, aircraft operations, and railroad movements.

Policies:

1) Continue to enforce the noise standards of the State Motor Vehicle Code and other State and Federal legislation pertaining to motor vehicle noise.

2) Employ noise mitigation practices, as necessary, when designing future streets and highways, and when improvements occur along existing road segments. Mitigation measures should emphasize the establishment of natural buffers or setbacks between the arterial roadways and adjoining noise-sensitive areas.

3) Require that development generating increased traffic and subsequent increases in the ambient noise level adjacent to noise-sensitive land uses provide appropriate mitigation measures.

4) Maintain roadways so that the paving is in good condition to reduce noise-generating cracks, bumps, and potholes.

5) Require sound walls, berms and landscaping along existing and future freeways and railroad rights-of-way to beautify the landscape and reduce noise, where appropriate.

6) Encourage the construction of noise barriers by the Public Utilities Commission, Southern California Regional Rail Authority, Union Pacific, Burlington Northern & Santa Fe and Amtrak where residences exist next to the track.

7) Encourage the Public Utilities Commission, Southern California Regional Rail Authority, Union Pacific, Burlington Northern & Santa Fe and Amtrak to minimize the level of noise produced by train movements and whistle noise within the City by reducing the number of nighttime operations, improving

vehicle system technology and developing improved sound barriers where residences exist next to the track.

8) Encourage the use sound-deadening matting (as opposed to wood) leading to, from and between the rails where public roads cross tracks in residential areas.

9) Require private heliports/helistops to comply with the City noise ordinances and Federal Aviation Administration standards.

10) Participate in the planning activities of County, regional and State agencies relative to the location of new airports and the assessment of their impact on the environment of the City.

11) Encourage the development of alternative transportation modes that minimize noise within residential areas.

12) Monitor proposals for future transit systems and require noise control to be considered in the selection of transportation systems that may affect the City.

13) Continue efforts to minimize the impacts from police helicopter training and emergency response activities through the potential relocation of helicopter facilities and careful consideration of flight paths.

Non-Transportation Related Noise Sources

The City currently maintains a diversity of land uses, most of which generate their own noise. Industrial facilities generate noise through various processes that involve the use of heavy equipment and machinery. However, even commercial facilities and residential units can generate noise from the use of heating, ventilating, and air conditioning (HVAC) units. Restaurants, bars, and entertainment establishments may use sound amplification equipment that operates well into the night. Residential areas are also subject to noise from the use of pool and spa pumps, landscape maintenance equipment, barking dogs, etc.

Mixed-use areas that place more sensitive residential uses alongside or above commercial uses can present their own challenges. Requiring that the commercial component meet a residential standard could make commercial operations difficult. Alternatively, applying a commercial standard to a mixed-use project could result in unacceptable noise levels at the residential portion of the structure/site. Still, mixed-use projects offer several advantages from both an air quality and transportation perspective, and should be encouraged.

The most prominent non-transportation related noise production occurs at the three major attraction venues in the City: The Anaheim Resort®, Angel Stadium of Anaheim,

and the Arrowhead Pond of Anaheim. These uses involve the use of delivery vehicles, rides and attractions, and attract thousands of people and automobiles that can create high levels of noise. Within the property lines of these uses, however, the noise levels are generally considered acceptable and appropriate to the use. Moreover, these uses employ large setbacks, parking buffers, and a variety of sound barriers to minimize noise impacts.

The noise impacts on the area surrounding Angel Stadium of Anaheim is also limited due to the industrial nature of the surrounding development. However, as The Platinum Triangle transitions into a mixed-use center and incorporates more sensitive land uses, the potential for noise conflicts may rise. Any new development, therefore, will be required to incorporate appropriate sound mitigation measures to minimize the noise impacts from and to the surrounding environment.

Another source of "non-transportation" noise comes from the operations of trucks and trains within the City. As previously mentioned, the operation of railroad trains and heavy trucks is preempted from local noise regulation while operating on public roads and dedicated rights-of-way. However, noise is also generated by operations (e.g., idling, loading, and unloading) that occur at facilities. Once on private property, these sources are no longer considered preempted and the City has authority to regulate this noise if it "spills" into adjacent areas.

Finally, construction in all land use zones can temporarily elevate noise. The City recognizes that construction is a necessity and noise control for construction needs to be carefully balanced. Still, various measures are available to reduce this noise when necessary.

GOAL 3.1:

Protect residents from the effects of "spill over" or nuisance noise emanating from the City's activity centers.

Policies:

1) Discourage new projects located in commercial or entertainment areas from exceeding stationary-source noise standards at the property line of proximate residential or commercial uses, as appropriate.

2) Prohibit new industrial uses from exceeding commercial or residential stationary-source noise standards at the most proximate land uses, as appropriate. (Industrial noise may spill over to proximate industrial uses so long as the combined noise does not exceed the appropriate industrial standards.)

3) Enforce standards to regulate noise from construction activities. Particular emphasis shall be placed on the restriction of the hours in which work other

than emergency work may occur. Discourage construction on weekends or holidays except in the case of construction proximate to schools where these operations could disturb the classroom environment.

4) Require that construction equipment operate with mufflers and intake silencers no less effective than originally equipped.

5) Encourage the use of portable noise barriers for heavy equipment operations performed within 100 feet of existing residences or make applicant provide evidence as to why the use of such barriers is infeasible.

(Res. 2005-19, February 15, 2005)

Chapter 6.70 SOUND PRESSURE LEVELS

Sections:

6.70.010 ESTABLISHED.

Sound produced in excess of the sound pressure levels permitted herein are hereby determined to be objectionable and constitute an infringement upon the right and quiet enjoyment ofproperty in this City.

No person shall within the City create any sound radiated for extended periods from any premises which produces asound pressure level at any point on the property line in excess of sixty decibels (Re 0.0002 Microbar) read on the A-scale of a sound level meter. Readings shall be taken in accordance with the instrument manufacturer's instructions, using the slowest meter response.

The sound level measuring microphone shall be placed at any point on the property line, but not closer than three (3) feet from any wall and not less than three (3) feet above the ground, where the above listed maximum sound pressure level shall apply. At any point the measured level shall be the average of not less than three (3) readings taken at two (2) minute intervals. To have valid readings, the levels must be five (5) decibels or more above the levels prevailing at the same point when the source's ofthe alleged objectionable sound are not operating.

Sound pressure levels shall be measured with a sound level meter manufactured according to American Standard S1.4-1961 published by the American Standards Association, Inc., New York City, New York.

Traffic sounds sound created by emergencyactivities and sound created by governmental units or their contractors shall be exempt from the applications of this chapter. Sound created by construction or building repair of any premises within the City shall be exempt from the applications of this chapter during the hours of 7:00 a.m. to 7:00 p.m. Additional work hours may be permitted if deemed necessary by the Director of Public Works or Building Official. (Ord. 2526 § 1 (part); June 18, 1968; Ord. 3400 § 1; February 11, 1975: Ord. 6020 § 1; April 25, 2006.)

6.70.020 VIOLATIONS AND PENALTIES.

The first violation of this chapter by any person shall be punishable as an infraction in accordance with applicable provisions of the California Penal Code and the California Government Code. The second and all subsequent violations of said chapter committed by such person shall be punishable as a misdemeanor. (Ord. 5929 § 9; July 27, 2004.)

6.70.030 ENFORCEMENT.

The Code Enforcement Manager of the City of Anaheim shall enforce the provisions of this chapter. (Ord. 5812 § 25; June 11, 2002.)

CONSTRUCTION NOISE MODELING

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/16/2023
Case Description: ASD-11

**** Receptor #1 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
Architectural Coating	Residential	60.0	55.0	50.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Compressor (air)	No	40		77.7	50.0	0.0

Results

Equipment	Calculated (dBA) Lmax	Leq	Noise Limits (dBA) Day Lmax	Leq	Evening Lmax	Leq	Night Lmax	Leq	Noise Limit Exceedance (dBA) Day Lmax	Leq	Evening Lmax	Leq	Night Lmax	Leq
Compressor (air)	77.7	73.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	77.7	73.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/16/2023
Case Description: ASD-11

**** Receptor #1 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
Building Construction	Residential	60.0	55.0	50.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Crane	No	16	80.6	50.0	0.0	
Front End Loader	No	40	79.1	50.0	0.0	
Tractor	No	40	84.0	50.0	0.0	

Results

Equipment	Calculated (dBA) Lmax	Leq	Noise Limits (dBA) Day Lmax	Leq	Evening Lmax	Leq	Night Lmax	Leq	Noise Limit Exceedance (dBA) Day Lmax	Leq	Evening Lmax	Leq	Night Lmax	Leq
Crane	80.6	72.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	84.0	81.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/16/2023
Case Description: ASD-11

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
Building Demolition	Residential	60.0	55.0	50.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Concrete Saw	No	20		89.6	50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Dozer	No	40		81.7	50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA)				Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Concrete Saw	89.6	82.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer	81.7	77.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	89.6	84.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/16/2023
Case Description: ASD-11

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
Rough Grading	Residential	60.0	55.0	50.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Grader	No	40	85.0		50.0	0.0
Dozer	No	40		81.7	50.0	0.0
Tractor	No	40	84.0		50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA)				Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Grader	85.0	81.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer	81.7	77.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	85.0	84.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/16/2023
Case Description: ASD-11

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
Finishing and Landscaping	Residential	60.0	55.0	50.0

Equipment

Description	Impact Device	Spec Usage (%)	Actual Lmax (dBA)	Receptor Lmax (dBA)	Estimated Distance (feet)	Shielding (dBA)
Excavator	No	40	80.7	50.0	0.0	

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/16/2023
Case Description: ASD-11

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
Paving	Residential	60.0	55.0	50.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Paver	No	50		77.2	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Roller	No	20		80.0	50.0	0.0

Results

Equipment	Calculated (dBA) Lmax	Calculated (dBA) Leq	Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq	Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq
Paver	77.2	74.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	80.0	73.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	89.5	83.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/16/2023
Case Description: ASD-11

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
Rough Grading	Residential	60.0	55.0	50.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Grader	No	40	85.0		50.0	0.0
Dozer	No	40		81.7	50.0	0.0
Tractor	No	40	84.0		50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA)				Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Grader	85.0	81.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer	81.7	77.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	85.0	84.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/16/2023
Case Description: ASD-11

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
Site Preparation	Residential	60.0	55.0	50.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Tractor	No	40	84.0		50.0	0.0
Excavator	No	40		80.7	50.0	0.0
Scraper	No	40		83.6	50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA)				Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Scraper	83.6	79.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	84.0	83.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/16/2023
Case Description: ASD-11

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
Utilities Trenching	Residential	60.0	55.0	50.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Concrete Saw	No	20		89.6	50.0	0.0
Tractor	No	40	84.0		50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA)				Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Concrete Saw	89.6	82.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	89.6	84.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

ASD-11 - Construction Noise Modeling Attenuation Calculations

Levels in dBA Leq

Phase	RCNM Reference Noise Level	Receptor to North	Receptor to East	Receptor to South	Receptor to West
Distance in feet	*50*	*305*	*250*	*370*	*250*
Demolition	85	69	71	67	71
Site Prep	84	68	70	66	70
Rough and Fine Grading	85	69	71	67	71
Distance in feet	*50*	*150*	*65*	*55*	*400*
Building Construction	82	72	80	81	64
Architectural Coating	74	64	71	73	56
Distance in feet	*50*	*550*	*250*	*125*	*250*
Paving	84	63	70	76	70
Distance in feet	*50*	*100*	*100*	*100*	*100*
Utilities Trenching	85	78	78	78	78
Finish/Landscaping	77	71	71	71	71

Attenuation calculated through Inverse Square Law: Lp(R2) = Lp(R1) - 20Log(R2/R1)

ASD-11 - Vibration Damage Attenuation Calculations

Levels in in/sec PPV

Distance in feet	**Vibration Reference Level at *25 feet***	**Receptor to North** *5*	**Receptor to East** *5*	**Receptor to South** *60*	**Receptor to West** *15*
Vibratory Roller	0.21	2.348	NA	0.056	0.452
Large Bulldozer	0.089	NA	0.995	0.024	0.191
Loaded Trucks	0.076	0.850	0.850	0.020	0.164
Jackhammer	0.035	NA	0.391	0.009	0.075
Small Bulldozer	0.003	NA	0.034	0.001	0.006
Static Roller	0.05	0.559	NA	0.013	0.108

STATIONARY NOISE MODELING

ASD-11 - Stationary Noise Modeling Attenuation Calculations

Phase	HVAC Reference Level	Receptor to North
Distance in feet	*3*	*50*
Demolition	72.0	48